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PASSIVE DEHUMIDIFICATION AND AIR CIRCULATION VENTILATION SYSTEM FOR NORTHERN RURAL HOUSING IN ALBERTA

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INTRODUCTION

Many small wood-framed and wood-heated homes in northern rural areas of Alberta suffer from extreme interior condensation problems. Many have limited or intermittent hand-fired heating systems, partially insulated and poorly sealed exterior envelopes and high levels of occupant-generated water vapor. Condensation problems, including mould and mildew growth cause degradation of finishes and structural elements, and create a need for a simple and cost effective moisture removal strategy.

OBJECTIVE

The objective of this project was to explore unconventional approaches to ventilation and moisture (humidity) removal that respect the resident's lifestyle while not imposing an unrealistic economic or maintenance burden. The study focused on ventilation/dehumidification systems which are driven by natural and free forces such as the stack effect and differential wind and vapor pressures between the interior and exterior environment.

METHOD

The worked commenced with an extensive literature review. It also focused on theoretical analyses of humidity problems to establish a basis for developing new approaches. Site visits to houses in the Chipewyan and Peerless Lakes areas helped to provide an understanding of the lifestyles and construction environment in which the system(s) must operate.

The first phase of the work led to the development of a design for a ventilation system driven by air pressure differentials between the windward and leeward sides of the home.

The second phase of the work involved a comparative analysis of ventilation, diffusion and condensation plates as dehumidification strategies. Based on the analysis, five alternate wall assemblies were developed and tested in a laboratory setting to determine their ability to diffuse moisture vapor to the exterior. The general assembly consisted of a 600 mm x 600 mm wood frame in which different insulation batt configurations and vapor/air barrier coverings were placed and tested.

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In two of the test panels, oriented glass fibre insulation board was placed near the top of the wall, where most frost buildup occurred, to test its effectiveness in channelling moisture to the exterior. Four configurations employing the oriented glass fibre insulation board were tested.

FINDINGS

Test assemblies without oriented glass fibre board were found to be inappropriate because of high rates of frost accumulation. For those panels incorporating the oriented glass fibre board, the exposed oriented glass fibre insulation board suffered frost accumulation at a much slower rate than the associated batt insulation. For one panel, after a 7.9 day duration test, frost increased the insulated board weight by 16.8% and the batt insulation weight by 98.1%. Further, air flow and vapor transmission at 5Pa remained fairly constant through the oriented glass fibre insulation board.

When allowed to thaw at room temperature, the batt insulation frost was released as water while no water was collected from the insulation board.

CONCLUSIONS

Oriented glass fibre insulation board appears to be a feasible method of channelling the moisture vapor to the exterior with limited interruption. Moisture that condenses out as frost in the board is held hygroscopically until it evaporates and escapes the board as vapor; consequently no problems occur as the moist interior air vents past the dew point in the wall. Based upon the findings it was calculated that in order to vent the moisture generated by the average family, the insulated board vents would only need to expel 4% of the total home air volume per day. When translated into heating costs, it was estimated that the dehumidification costs for a large family would be approximately $15 per month.

The report contains proposals and construction details for a field trial and evaluation of the vent concept. This report will be of interest to those individuals and agencies engaged in the research and evaluation of alternate, efficient, low-technology, low-maintenance moisture control strategies.